Patent claims

1. Method for recording, measuring, and documenting damages, in particular deformations such as depressions or the like that are caused by sudden events, for instance hailstorms, to painted surfaces, in particular body parts of vehicles, in which the surface to be examined on the vehicle is scanned with light from at least one highly focusing light source in a lattice- or grid-pattern and with the light reflected on the surface a surface image is produced on a screen, which is recorded by a recording, evaluation, and signal processing device and in this the surface damages are determined using a certain evaluation algorithm and are output for objectively documenting the damages, characterized in that, by a controlled displacement and/or pivoting between light source and screen and by a controlled rotational and/or displacement and/or pivoting movement of the vehicle, matched to the displacement or pivot, about or along its longitudinal and/or vertical axis within a support frame, the surface to be scanned is brought into the reflection position to the light source and the screen and the recording device is brought into the imaging position to the reflected light, whereby the movements of light source, screen, recording device, and vehicle are controlled by a processor unit.

2. Method in accordance with claim 1, characterized in that a container support frame or a mobile container frame is used for the support frame for the light source, screen, and vehicle.

3. Method in accordance with claims 1 and 2, characterized in that the light source is displaced along horizontal and/or vertical slide rails on the supports of the support frame.

4. Method in accordance with claims 1 and 2, characterized in that the screen is displaced along horizontal slide rails on the supports of the support frame.

5. Method in accordance with claims 1 through 4, characterized in that the light source and the screen are displaced while the vehicle is stationary in the support frame.

6. Method in accordance with claims 1 or 2, characterized in that the vehicle is displaced while the light source is stationary.

7. Method in accordance with claims 1 and 2, characterized in that the vehicle is held on a rotatable and/or displaceable and/or pivotable measurement table in the support frame during scanning.

8. Method in accordance with claims 1 through 7, characterized in that laser light, pulsed flashlight, or infrared light is used for the light source.

9. Method in accordance with claim 8, characterized in that gas lasers such as excimer lasers, argon or krypton ion lasers, chemical lasers, CO lasers, CO_2 lasers, optically pumped molecular lasers, and solid state lasers and semiconductor lasers are used for the laser.

10. Method in accordance with claims 1 through 9, characterized in that the light is guided through the surface to be scanned, in that the surface is scanned in successive lines, whereby the advance when the beam is displaced is smaller than the beam diameter.

11. Method in accordance with claims 1 through 9, characterized in that the reflected light beams are deflected directly onto the screen with simultaneous enlargement of the image scale of the surface.

12. Method in accordance with any of claims 1 through 10, characterized in that a screen, matte glass pane, light-sensitive plate, or self-reflecting projection wall is used for the screen on which the scanned surface is made visible in the form of an analog image.

13. Method in accordance with claim 12, characterized in that the analog image is recorded, documented, and evaluated by means of conventional recording methods, for instance photography.

14. Method in accordance with claim 12, characterized in that the analog image recorded by means of digital photography is stored in a processor, processed by means of image processing software, displayed on a monitor in an analog manner, and output by a printer.

15. Method in accordance with claims 1 through 10, characterized in that used for the screen is an electro-optical receiver, for instance a diode array, that converts the analog image signals directly into digital signals and these signals are forwarded to the evaluation unit for display and output of an image and evaluation record.

16. Method in accordance with claims 1 through 15, characterized in that defects and/or damages in the surface are determined by comparing a calibration signature for the undamaged surface that is stored in the evaluation unit to the measured surface signature.

17. Method in accordance with claims 1 through 16, characterized in that the calibration signature is made visible in the measurement signature for identifying defects.

18. Method in accordance with claims 1 through 16, characterized in that the surface of the vehicle that is to be scanned is pretreated with an easily removable added coating that supports reflection and that is made of oil, glycerin, and/or water.

19. Apparatus for performing the method in accordance with claim 1 with a highly focusing light source (1) for illuminating a surface having deformations or damages to painted body parts of a vehicle (4), a deflection device for the light for linear and grid-pattern scanning of the surface, a screen (6) for imaging the surface by means of the light beams reflected by the surface, means (9) for recording the images, a processor (10) for processing and evaluating the images recorded, and means (11, 12) for displaying and outputting the results, characterized in that all devices (1, 6, 9, 10, 11, 12) and said vehicle (4) are arranged in and on a support frame (14) with upper and lower braces and with lateral and end braces (a, g, c, d, e, f, i, j) such that said light source (1) can travel and pivot horizontally and vertically along guide rails (16) running on said braces, said screen (6) is embodied horizontally displaceable and pivotable on said braces, and said vehicle (4) anchored to a measurement table (17) is rotatable about its [vehicle's] longitudinal or vertical axis (A-A), whereby each position of the painted surface of said vehicle can be brought into the reflection position with respect to said light source (1) and said screen (6), and in that a processor unit (19) is provided for correlating/coordinating the movements of said light source, screen, and vehicle.

20. Apparatus for performing the method in accordance with claim 1 with a highly focusing light source (1) for illuminating a surface having deformations or damages to painted body parts of a vehicle (4), a deflection device for the light for linear and grid-pattern scanning of the surface, a screen (6) for imaging the surface by means of the light beams reflected by the surface, means (9) for recording the images, a processor (10) for processing and evaluating the images recorded, and means (11, 12) for displaying and outputting the results, characterized in that all devices (1, 6, 9, 10, 11, 12) are arranged in and/or on a support frame (14) that can travel along said vehicle (4) such that said light source (1) can travel and pivot horizontally and vertically along guide rails (16) running on said braces of said support frame, said screen (6) is embodied horizontally displaceable and pivotable along said upper braces, and said vehicle (4) anchored to a measurement table (17) is rotatable about its [vehicle's] longitudinal or vertical axis (A-A), whereby each position of the painted surface of said vehicle can be brought into the reflection position with respect to said light source (1) and said screen (6), and in that a processor unit (19) is provided for correlating/coordinating the movements of said light source, screen, and vehicle.

21. Apparatus for performing the method in accordance with claim 1, with a highly focusing light source (1) for illuminating a surface having deformations or damages to painted body parts of a vehicle (4), a deflection device for the light for linear and grid-pattern scanning of the surface, a screen (6) for imaging the surface by means of the light beams reflected by the surface, means (9) for recording the images, a processor (10) for processing and evaluating the images recorded, and means (11, 12) for displaying and outputting the results, characterized in that all devices (1, 6, 9, 10, 11, 12) are arranged in and/or on a stationary support frame (14) such that said light source (1) can travel and pivot horizontally and vertically along guide rails (16) running on said braces of said support frame, said screen (6) is embodied displaceable and pivotable along said horizontal braces, and said vehicle (4) can pass through said support frame in a prespecified direction and speed, whereby each position of the painted surface of said vehicle can be brought into the reflection position with respect to said light source (1) and said screen (6), and in that a processor unit (19) is provided for correlating/coordinating the movements of said light source, screen, and vehicle.

22. Apparatus in accordance with claim 19, characterized in that said support frame (14) is a container support frame, the side walls (15) and end walls (21) of which are embodied pivotable

about said horizontal or vertical braces such that a support frame that is open on the end walls and side walls results for accommodating and scanning said vehicle.

23. Apparatus in accordance with claims 20 and 22, characterized in that said braces of said support frame are embodied such that they can be put together and such that they are lockable.

24. Apparatus in accordance with claims 19 through 21, characterized in that separated off in said support frame (14) is a communications and/or operator space (20) in which are arranged said means (10) for image processing, said processor unit (19) for coordinating the movements of said light source (1), screen (6), and vehicle (4), said means (11, 12) for displaying and outputting said measurement results, and said means for communication.

25. Apparatus in accordance with claim 24, characterized in that said communications and operator space (20) is heat- and sound-insulated.

26. Apparatus in accordance with claim 19, characterized in that said support frame is part of a mobile vehicle, for instance a truck or the like.

27. Apparatus in accordance with claims 19 through 26, characterized in that said light source (1) is a laser light, pulsed flashlight, or infrared light.

28. Apparatus in accordance with claim 27, characterized in that said laser light (1) is a gas laser such as an excimer laser, argon ion laser, chemical laser, CO laser, CO_2 laser, optically pumped molecular laser, solid state laser, or semiconductor laser.

29. Apparatus in accordance with claims 19 through 21, characterized in that said screen (6) is a screen, matte glass pane, light-sensitive plate, or self-reflecting projection wall.

30. Apparatus in accordance with claims 19 through 21, characterized in that said screen (6) is an electro-optical receiver, for instance a diode array.

31. Apparatus in accordance with claims 19 through 21, characterized in that said means (9) for recording the surface image are those of a photographic camera, a digital camera, or a web cam.

32. Apparatus in accordance with claims 19 through 21, characterized in that said means for displaying and outputting the measurement results are those of a monitor and printer.